TITLE: UNDERSEA HYDRAULIC COUPLING FOR USE WITH MANIFOLD PLATES

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BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates, in general, to hydraulic couplings, and specifically to hydraulic couplings used in undersea drilling and production applications. More particularly, the invention involves an alignment system designed to provide proper alignment when the male and/or female member of a hydraulic coupling is attached to a manifold plate.

2. Description of Related Art

[0002] Subsea hydraulic couplings are old in the art. The couplings generally consist of a male member and a female member with sealed fluid passage ways connecting there between. The female member generally is a cylindrical body with a relatively large diameter longitudinal bore at one end and a relatively small diameter longitudinal bore or tail at the other. The tail facilitates insertion through manifold plates, and connections to hydraulic lines, while the large bore seals, and slidingly engages, the male member of the coupling. The male member includes a cylindrical portion at one end having an outer diameter approximately equal to the diameter of the large bore in the female member of the coupling. The male member also includes a tail connection at its other end to facilitate insertion through a manifold plate, and connection to hydraulic lines. When the cylindrical portion of the male member is inserted into the large bore of the female member, according to various embodiments of the device, fluid flow is established between the male and female members.

[0003] Typically, both the female and male portion of the hydraulic coupling have each been fixedly attached to manifold plates. The manifold plates are brought together to mate the hydraulic coupling. Hydraulic lines are attached to the distal end of the female and male couplings on the opposite side of each manifold plate.

[0004] Generally in the past, the manifold plates and the associated hydraulic coupling portions have been arranged such that the coupling portion is in a vertical or near vertical position. Additionally, the coupling portions in prior art systems have been screwed into threads inside holes cut through the manifold plates. The process of

threading the manifold plates requires precision machining and is expensive and time consuming. What is needed is a way to cut plain, unthreaded holes through the manifold plates to connect hydraulic coupling portions there through. However, when the manifold plates are positioned such that the hydraulic coupling portions extend from the manifold plate at a significantly non-vertical angle, unless the fit between the manifold plate and the hydraulic coupling is precision cut for an exact fit, the hydraulic coupling portion will misalign or sag. If that occurs, two adverse effects occur. First when the manifold plates containing the male and female members are brought together, because the couplings are not lined up properly, galling can occur reducing the ability to maintain pressurized fluid integrity. Second, when the hydraulic lines are connected to the distal ends of the male and female coupling portions, if the couplings are not perpendicular to the manifold plate it will cause the hydraulic line to bend or crimp. This can cause an early fail point in the hydraulic line.

[0005] What is needed is a hydraulic coupling that can be used in manifold plates having a smooth bore hole larger than the outer bore of the portion of the coupling to be inserted through the manifold plate, wherein the hydraulic coupling has an alignment system causing it to remain substantially perpendicular to the hydraulic plate no matter what position the hydraulic plate is in.

SUMMARY OF THE INVENTION

[0006] The present invention provides a tail on the non-coupling end of both a male and female member of a hydraulic coupling device. The tail is machined to fit through pre-cut, holes in a manifold plate. The clearance between the outer diameter of the tail and the inner diameter of the hole in the manifold plate is such that the tail will fit easily through the hole. The tail has positioning members on its outer diameter that when inserted fully into the hole in the manifold the positioning members compress to an interference fit which will hold the coupling in a nominal, substantially perpendicular, position to the manifold plate. Additionally, the retaining ring that holds the tail in place in the hole in the manifold plate can also have a positioning member that compresses against the manifold plate opposite of the male or female end of the coupling to hold the coupling in a nominal position to the plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The following drawings form part of the present specification and are included to further demonstrate certain aspects of the present invention. The invention may be better understood by reference to one or more of these drawings in combination with the detailed description of specific embodiments presented herein.

[0008] FIG. 1 is a sectional view of a prior art configuration of a male and female portion of a hydraulic coupling each fixedly attached with a threaded connection to a manifold plate.

[0009] FIG. 2 is a sectional view of the male member of the coupling according to a first embodiment, with the tail of the male member inserted into a manifold plate.

[00010] FIG. 3 is a sectional view of the female member of the coupling according to the first embodiment, with the tail of the female member inserted into a manifold plate.

[00011] FIG. 4 is a sectional view of a male member of the coupling according to a second embodiment, with the tail of the male member inserted into a manifold plate.

[00012] FIG. 5 is a sectional view of a female member of the coupling according to the second embodiment, with the tail of the female member inserted into a manifold plate.

[00013] DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[00014] FIG. 1 shows a prior art hydraulic coupling connection to manifold plates. As can be seen in FIG. 1, manifold plate 4 is fixedly connected to female member 6 through the threaded connection 12. Likewise, manifold plate 2 is fixedly connected to male member 8 through threaded connection 10. This prior art device is shown in more detail in U.S. Patent No. 6,202,690. This prior art device has the disadvantage of having the expense of threading the inside of the holes in the manifold plates 2 and 4. The present invention solves this problem and provides additional flexibility in the connection between the coupling members and the hydraulic plates.

[00015] In FIG. 2, a first embodiment of the undersea hydraulic coupling of the present invention is shown. FIG. 2 shows the male member of the coupling and its attachment to a manifold plate. The manifold plate 16 can be any thickness, but preferred standard thicknesses are 1 ¼ inch or 2 inch. The male member 14 of the hydraulic coupling is shown as having tail 18 which extends through manifold plate 16. Once the tail 18 is inserted through the manifold plate 16, it is held in place by retainer ring 20,

which is held in locking position by snap ring 22 that fits into groove 24 that extends radially around the circumference of the tail 18. Of course, the retaining ring 20 could be threaded on or held in place through any number of alternatives that will be apparent to those of skill in the art. As can be seen in FIG. 2, there is a radial space 26 between the body of the tail 18 and the inner bore of the hole in manifold plate 16. Preferably the radial space 26 will be in the range of 0.025-0.050 inches. As will be further seen, the retainer ring 20 is not in tight fit with manifold plate 16, leaving gap 28 as well. Gap 28 is also preferably in the range of 0.025-0.050 inches. Because of radial space 26 and gap 28, the male member 14 may shift so as not to be nominal (substantially perpendicular) to the manifold plate 16. This will be particularly true due to cantilevering when plate 16 is turned vertically so that male member 14 extends horizontally therefrom. The present embodiment prevents the tail 18 of the male member 14 from shifting, even when extending horizontally, through the use of substantially rigid positioning members 30 extending around the circumference of the tail 18 in grooves cut into the tail 18. The positioning members 30 are preferably elasomeric o-rings. The o-rings 30 have enough rigidity to hold the male member 14 nominal to the manifold plate 16. The end of the tail 36 of female member 32 that extends through manifold plate 34 is used to connect to hydraulic lines.

[00016] The o-rings of this embodiment are one type of a substantially rigid positioning member. The o-rings are not for the purpose of sealing, and are not required to main seal integrity. As those of skill in the art will note, the o-rings 30 of this embodiment may be replaced with any element that provides enough give to allow the tail 18 to be inserted, but enough rigidity to hold the male member 14 nominal. Additionally, rather than having o-rings around the circumference of the tail 18, there could be fins that run longitudinally on the tail or any other suitable arrangement.

[00017] FIG. 3 shows the female member that mates with the male member of FIG. 2 and the tail structure of the female member that connects through its manifold plate. The female member 32 connects through manifold plate 34. The manifold plate 34 can be any thickness, but preferred standard thicknesses are 1 ¼ inch or 2 inch. The male member 32 of the hydraulic coupling is shown as having tail 36 which extends through manifold plate 34. Once the tail 36 is inserted through the manifold plate 34, it is held in

place by retainer ring 38, which is held in locking position by snap ring 40 that fits into groove 42 that extends radially around the circumference of the tail 36. In FIG. 3, as there was in FIG. 2, there is a radial space 44 between the body of the tail 36 and the inner bore of the hole in manifold plate 34. Preferably the radial space 44 will be in the range of 0.025-0.050 inches. As will be further seen, the retainer ring 38 is not in tight fit with manifold plate 34, leaving gap 46 as well. Preferably gap 46 is in the range of 0.025 – 0.050 inches. Because of radial space 44 and gap 46, the female member 32 may shift in the manifold plate 34 so as not to be nominal (substantially perpendicular) to the plate. The present embodiment prevents the tail 36 of the female member 32 from shifting, even when extending horizontally, through the use of substantially rigid positioning members 48 extending around the circumference of the tail 36 in grooves cut into the tail 36. The substantially rigid positioning members 48 are preferably elastomeric o-rings that have enough rigidity to hold the female member 32 nominal to the manifold plate 34. The end of the tail 36 of female member 32 that extends through manifold plate 34 is used to connect to hydraulic lines.

[00018] FIG. 4 shows another embodiment of the present invention showing a male member of a hydraulic coupling attached to a hydraulic plate as shown in FIG. 2 with the addition of an additional substantially rigid positioning member associated with the retainer ring. In FIG. 4, components that are the same as FIG. 2 bear the same component number as those of FIG. 2. In FIG. 4, in addition to o-rings 30 that help hold the male member 14 in a nominal relationship with hydraulic plate 16, a modified retainer ring 50 is used. The modified retainer ring 50 has a groove cut into the radial face that engages with the manifold plate 16. Another substantially rigid positioning member 52, preferably an o-ring, is inserted in the groove in the modified retainer ring 50. The o-ring 52 is in contact with the modified retainer ring 50 and the manifold plate 16 so as to further resist cantilevering of the male member 14.

[00019] As shown in Figs. 2-4, the manifold plates are shown as having a 1 ¼ inch thickness. The tail 18 of the male member 14 of FIG. 4 could be extended an additional 1-1½ inches. An additional groove 24 could be cut around the circumference of the tail an additional ¾ inches out on the tail 18 so that the tail 18 will be capable of being attached to a 1 ¼ inch or 2 inch manifold plate 16 without further modification. For

attachment to the thicker manifold plate, the modified retainer ring 50 would simply be held in place by a snap ring in the new groove ¾ inches further out on the tail 18. This modification could be made to the tail shown in each of the embodiments.

[00020] FIG. 5 shows the female member of FIG. 3 with the modified retainer ring of FIG. 4. All like numbered components in FIG. 5 are the same as the component in FIG. 3 and FIG. 4. The tail could be extended for thicker hydraulic plates as described above as well.

[00021] Those of skill in the art will understand that portions of each of these embodiments may be combined or eliminated to create substantially equivalent embodiments to meet the objectives of the present invention to prevent cantilevering of hydraulic coupling components attached to hydraulic plates with fixed attachment such as with a threaded connection.